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ABSTRACT

Contained in this manual are descriptions of the reaction of ornamental plants to diseases caused by fungi, bacteria, and viruses and mycoplasmas. Also described are insects which are associated with ornamentals. Examples of weeds found in ornamental or turf areas, such as crabgrass and chickweed, are described as well. Finally information is given on such turf diseases as pythium blight, brown patch, mushrooms, and nematode infestation. In addition, pesticide application and safety tips are given. (BB)

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Applicator Training Manual for:

ORNAMENTAL AND TURF PEST CONTROL

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UNIVERSITY OF KENTUCKY · COLLEGE OF AGRICULTURE · COOPERATIVE EXTENSION SERVICE
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Appreciation is expressed to the Georgia Cooperative Extension Service for materials used in the preparation of this publication.

Identification or recognition of pests is essential to proper pesticide application. Once the pest has been identified, the best method for controlling the pest must be chosen. If a pesticide is to be used, the commercial ornamental or turf pesticide applicator should know proper application techniques and understand potential dangers and side effects of the pesticide to be used since applications are frequently made near people and property. This publication provides information on the recognition of common insects and their resultant damage, weeds, and symptoms caused by disease agents on ornamentals and turf. Recommendations for control of these pests are available at your county Extension office.

ORNAMENTAL DISEASE INFORMATION

Infectious diseases of ornamentals and turf are caused by parasites: fungi, bacteria, viruses, mycoplasmas and nematodes. All the plant pathogens (parasites) discussed in this manual are microscopic in size. Because of the microscopic size of the organisms involved, disease identification requires a recognition of symptoms, the reaction of plants affected by these organisms. These symptoms may include leaf spotting, chlorosis, cankers, galls, wilting, and decay of roots.

Sometimes adverse growing conditions or environmental factors can cause plants to show symptoms similar to those of plant diseases. These problems need to be distinguished from plant diseases. Such things as frost injury, dog urine burn, nutrient deficiencies, wet feet, drought, girdling roots, changes in grade, chemical injury, air pollution injury and mechanical damage are not corrected by fungicide applications.

The disease-causing organism needs to be known so that the chemical or cultural practice used to control the problem will work. A root problem identified as a root rot when it is actually a nematode infestation will not be cured by applying a fungicide—a nematicide is required.

Accurate identification and diagnosis is an art as well as a science and experience is essential. This discussion is not intended to make anyone an expert in identifying diseases. It is meant to acquaint the pesticide applicator with the general symptoms that occur as a result of disease. For more accurate disease diagnosis, consult your county Extension agent.

Diseases Caused by Fungi

Fungi causing plant diseases are microscopic plants that feed on living green plants or on dead organic material. When they attack living plants, a disease occurs. Fungi usually produce spores which, when carried to a plant, can begin an infection. These spores may be carried from plant to plant by wind, water, insects and tools. In order for fungus spores to begin new infections, adequate moisture and the right air temperature are required. A plant wound is sometimes also needed as an entry for the fungus. Many fungal diseases are common during wet, humid seasons. Chemicals used to control fungi are fungicides. Usually, fungicides are applied to prevent rather than to cure fungus disease.

Leaf Spots:

Fungal leaf spots (other names: anthracnose, scab, leaf blotch, shot hole) are usually definite spots of varying sizes, shapes, and colors. The spots have a distinctive margin and are sometimes surrounded by a yellow halo. Spots or dead areas may enlarge to cover an entire leaf. As the spots become more abundant, leaves may yellow, die, and drop. Leaf spots usually first occur on the lower leaves and progress up the plant. Fungus growth in the spot may consist of tiny pimple-like structures or a moldy growth of spores. A hand lens or microscope may be needed to see these structures.

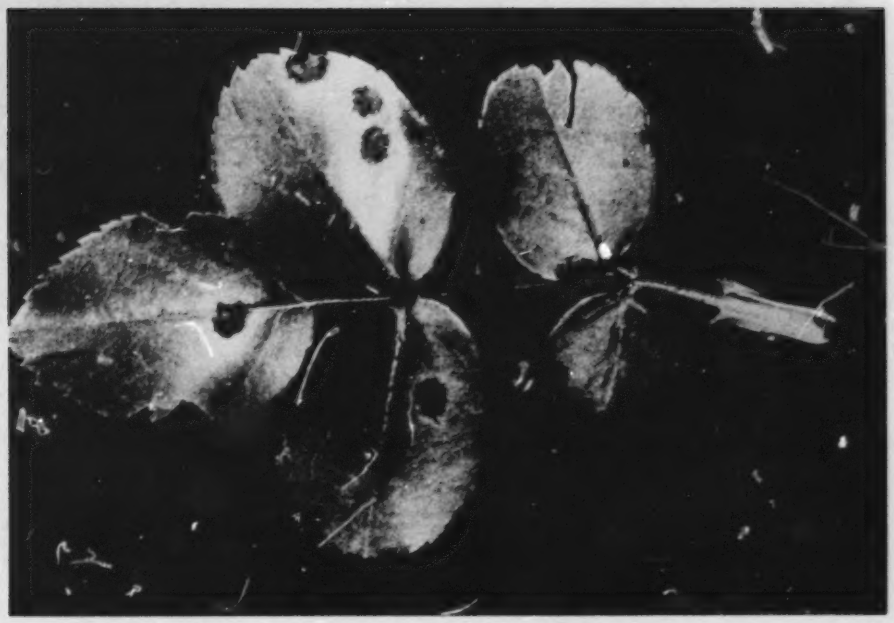

Figure 1. Black Spot - Rose

Leaf spots are more common in the early spring and fall when an abundance of moisture, necessary for infection, is present. When infected leaves fall and become part of the refuse around a plant, fungus spores may be produced. If carried to healthy plants, these spores can begin a new infection under appropriate environmental conditions. Leaf spots occur on virtually all ornamental plants.

Leaf blights may have the same effect on plants as leaf spots, but are generally larger diseased areas and less regular in shape.

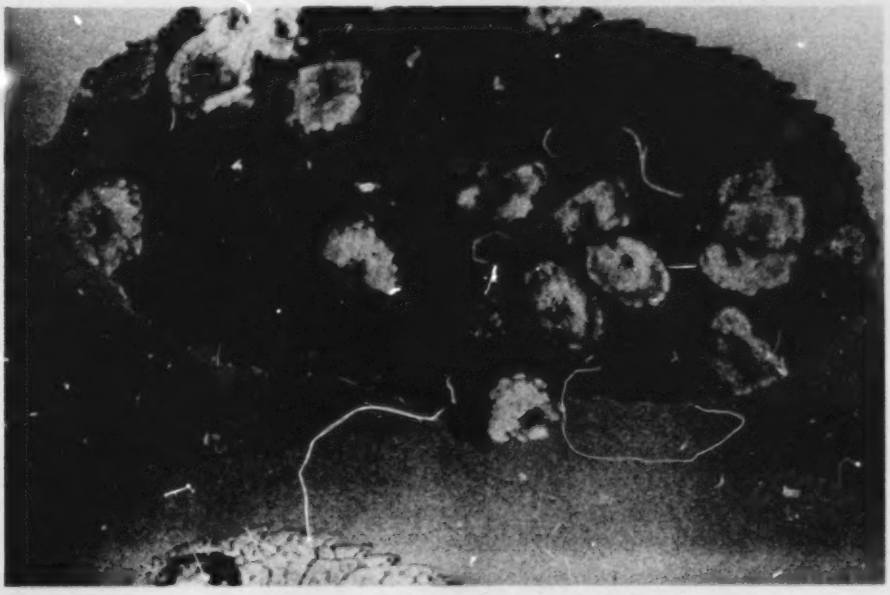

Figure 2. Cedar-Apple Rust - Flowering Crabapple

Figure 3. Cedar-Apple Rust - Cedar

Rust:

Rusts often produce spots similar to leaf spots, but the spots are called pustules. Pustules may be on the upper and/or lower leaf surface and are brown, reddish-brown, orange, or yellow. Rust pustules are usually raised above the leaf surface, and rubbing the affected leaf surface will leave a dusty rust color (caused by the spores) on the fingers. Rust Fungi may also attack twigs, branches, and fruit.

Rust spores are often carried by wind and can be blown from infected plants to other plants, spreading the infection.

Rust diseases have very complicated life cycles and, in many cases, require two separate hosts to complete their life cycle. In such cases, removing either one of the hosts can break the cycle and stop rust. Cedar-apple rust and related rusts are common ornamental disease problems.

Figure 4. Powdery Mildew - Rose

Powdery Mildew:

The typical symptom of powdery mildew is the white or gray layer of fungus growth produced on the surface of the plant leaves and stems. Plants affected by powdery mildew may also show crooked stems or bubbled and curled leaves. Spores produced by the fungus can be blown by the wind or carried by rainsplash to new plants, initiating new infections of powdery mildew. The fungus produces small, black, over-wintering structures which can withstand the cold winter. Roses, oaks, tulip poplars, lilacs, zinnias, and euonymous are commonly affected by powdery mildew.

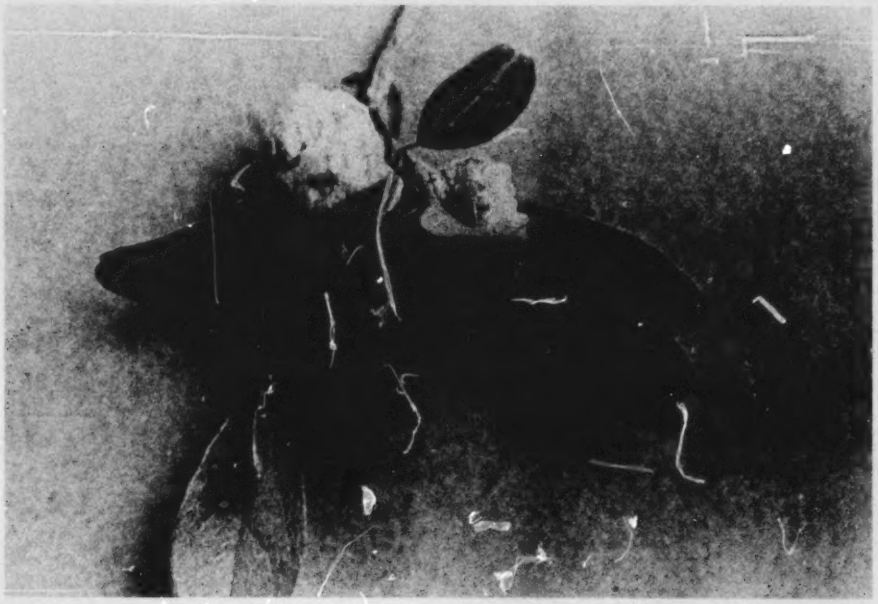

Figure 5. Azalea Leaf Gall

Leaf Galls:

Leaf gall diseases are caused by fungi and are favored by cool, moist weather. Leaf galls can usually be seen shortly after new growth begins in the spring. Part of the leaf becomes distorted with a pale green to whitish-colored, bladder-like thickening. The young, thickened, fleshy leaf is covered with a white growth. As the galls age they turn brown, dry up, and fall to the ground. If the disease is severe, plant vigor can be affected due to loss of leaves. The dead, dry leaves which have fallen to the ground will act as a source of spores for infection the following season. Leaf galls occur on azalea, camellia, and plum.

Root Rot:

The first symptoms of root rot generally appear on the above-ground parts as a gradual loss of vigor, yellowing of leaves, or wilting. Attempts to correct the problem with fertilizers and water generally yield little or no response. Diseased roots appear decayed, generally brown to black, and may be mushy or spongy. The fungi *Pythium, Phytophthora, Fusarium,* and *Rhizoctonia* are common root

Figure 6. *Pythium* Root Rot - Geranium

rotting organisms. These fungi normally inhabit most soils; excess soil moisture favors root rot disease on ornamental plants.

Figure 7. Seedling Stem Rot and Damping-Off

Stem Rot:

The pathogens commonly associated with stem rot of ornamentals include *Pythium, Phytophthora, Rhizoctonia, Sclerotium*, and *Botrytis*–all common, soil-inhabiting fungi. These fungi can be spread when soil is moved, in infected plant debris, or on cuttings.

Affected plants wilt slightly, become more severely wilted, and eventually die. The stems may be brown and shrunken at the soil line. Under extremely moist conditions, the white, cottony fungus mycelium may be visible on the surface of the stem. Chrysanthemums, geraniums, petunias, and other herbaceous ornamental plants are quite susceptible to stem rot.

Figure 8. *Nectria* **canker - Black Cherry**

Cankers:

Cankers are localized disease areas on trunks, stems or branches of woody plants such as shrubs and trees. Canker diseases result in a shrinking and dying of the bark tissues, which later crack open and expose the wood underneath. Cankers begin as small, discolored yellow, brown, or red spots which sometimes appear watersoaked. These spots enlarge and their centers may become tan or gray. Small, black, pimple-like structures—fungus fruiting bodies—may form in the canker. Cankers can enlarge and girdle the stem, causing death to parts of the plant above the canker. The fungi causing cankers usually begin infection in a wound or injury to the wood plant. Rose canker is a common example of a disease showing this symptom.

Figure 9. *Verticillium* **wilt - Jerusalem Cherry**

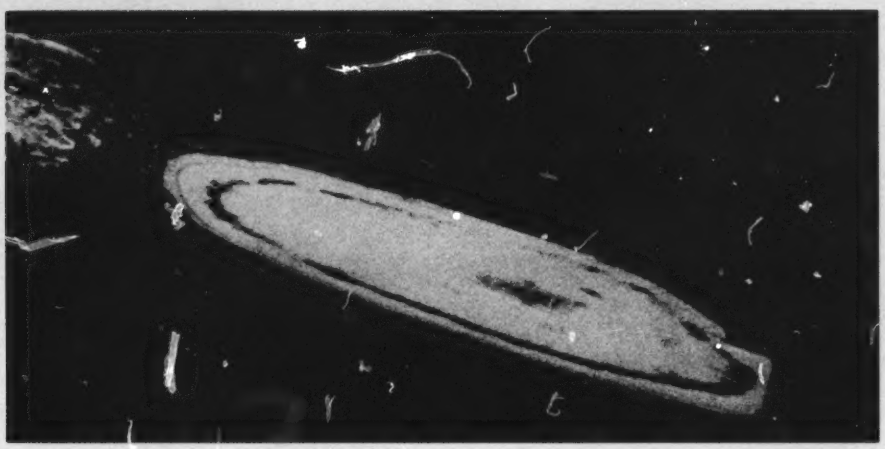

Figure 10. Discoloration of Maple Wood Caused by *Verticillium* wilt

Vascular Wilt:

Wilting is due to a deficiency of water in the leaves and stems. Fungus parasites such as *Fusarium, Verticillium* and *Ceratocystis* can cause wilting of many ornamental species. The wilting caused by such parasites is sometimes due to the toxins which they produce; later, the water-conducting vessels may become plugged by fungus growth. Vascular wilt diseases often affect one side of the plant first, causing individual limbs or branches to wilt and die back. *Fusarium* and *Verticillium* infections usually begin in the roots and gradually spread internally throughout the infected plant. *Verticillium* wilt of maple is an example of this kind of vascular wilt. The fungus *Ceratocystis*, the cause of Dutch Elm Disease, often initiates infections in the crotches of small branches in wounds created by the feeding of elm bark beetles. The wilt-causing fungus then gradually spreads internally throughout the tree, gradually killing it.

Diseases Caused by Bacteria

Bacteria are single-celled microscopic organisms. Some bacteria attack living plants and cause plant disease. Bacteria can be carried from plant to plant by wind, rain splash, insects and tools. Some bacterial diseases can be controlled using chemical bactericides.

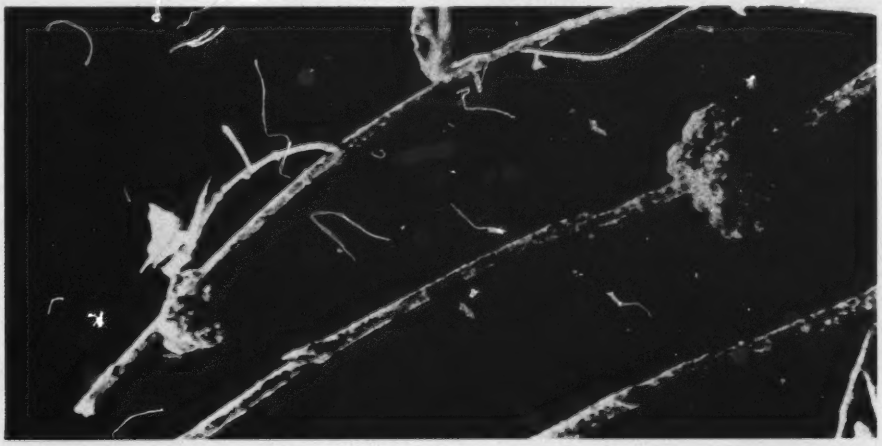

Figure 11. Crown Gall - Euonymus

Crown Gall:

Crown gall first appears as a soft swelling of the roots or stem. As the disease develops, the swelling enlarges, becoming firmer and darker. The outer surface of the gall may become rough.

Crown gall bacteria may survive in the soil for years from slowly decomposing galls from a previous crop. The bacteria enter the plant only through wounds and natural openings. Once inside, normal cell development of the plant is altered. After galls have fully developed, they begin to decompose and release additional bacteria which can reinfect the plant or infect new plants. Euonymous and rose are frequently affected by crown gall.

Figure 12. Bacterial Leaf Spot - Ivy

Bacterial Leaf Spot:

Bacterial leaf spot may begin as a light green, water-soaked area. Later, the spots may turn brown to black. Spots generally appear more irregular in shape than fungal leaf spots. Under warm, moist conditions, the leaf spot will appear soft and mushy. However, under dry conditions, the same spot may be brittle.

The bacteria generally overwinter in plant debris and are introduced to the plant in splashing rain or in watering. Bacteria do not enter the plant directly, but require either plant injury or a natural plant opening for entrance. Once the bacteria enter the plant and multiply enough to cause symptoms, leaves may fall prematurely. Such leaves act as a source of bacteria the following year. This disease occurs frequently on ivy.

Bacterial Blight:

Fire blight is perhaps the most common bacterial blight, affecting a large number of woody plants. It is commonly found on flowering crabapple, cotoneaster, and pyracantha.

Infection generally occurs in the spring and may be more damaging during long periods of cool, wet weather. The bacteria, which overwinter in stems and in bud scales, can be transported by bees during pollination so that symptoms may occur on blossoms and fruit spurs.

Figure 13. Fire Blight - Flowering Crabapple

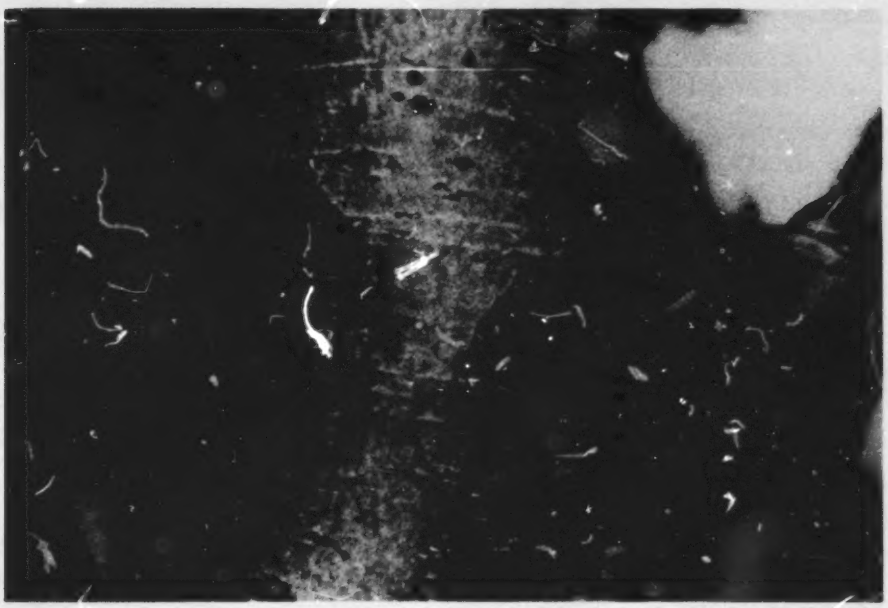

Figure 14. Fire Blight Canker - Flowering Crabapple

Symptoms first appear on new shoots. There is a dark discoloration as if the leaves and twigs have been scorched by fire. Later, discolored, sunken cankers may appear. Entire plants may be killed.

Diseases Caused by Nematodes

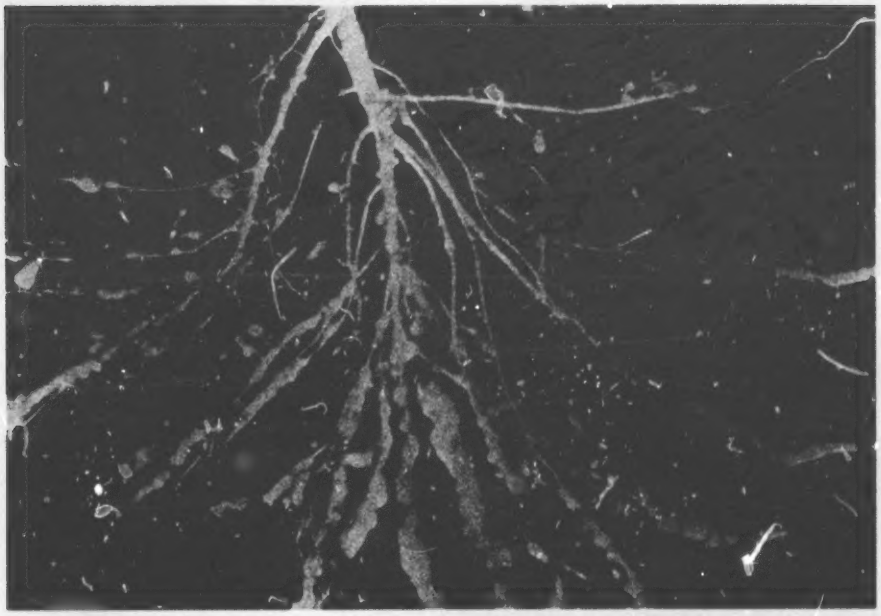

Figure 15. Root Knot Nematode Galls

Nematode Injury:

Nematodes are microscopic worms which live in the soil and feed on plant roots. In some cases they even feed on leaves and stems. Many different types occur in the soil and, under certain conditions, build up to high populations that can affect plant root development. Some nematodes cause swellings on roots; others simply kill the tips of feeder roots. The above-ground symptoms of nematode damage may include wilting, yellowing of foliage or stunting, and a general decline of the plant. It is difficult to distinguish between the symptoms of some kinds of nematode damage and root rot infection. Laboratory analysis of soil near the affected plant or an examination of the roots is essential for a definite diagnosis. Root-knot of boxwood is an example of a nematode disease of ornamentals.

Diseases Caused by Viruses and Mycoplasmas

Viruses and Mycoplasmas are very small microorganisms that cause plant diseases.

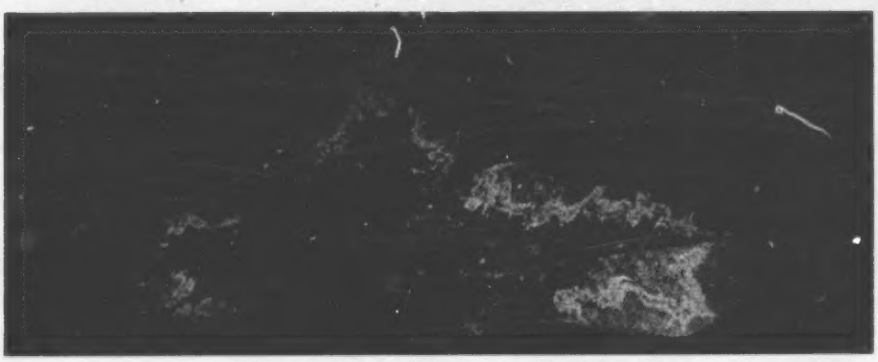

Figure 16. Rose Virus

Virus and Mycoplasma Problems:

Viruses and mycoplasmas infecting ornamentals usually produce symptoms such as chlorosis, mottling, ring spots and deformed growth. Infection occurs in wounds made by insects or mechanical means. These pathogens can be carried from one plant to another by feeding insects, on or in seeds, by pruning equipment, or by hands and clothing of workers. These diseases, which may affect woody and herbaceous ornamentals, are not usually controlled using chemicals.

ORNAMENTAL INSECTS

There are many types and kinds of ornamental plants, and there are many types and kinds of insects associated with them. Many of these insects are pests, but others may be predators or parasites of the pests. Still others may be neutral insects that collect nectar or pollen or scavenge on plants. You cannot possibly identify all of the insects you may find, so you will need help from your County Extension Agent for Agriculture, Extension Entomologist, or other source. Some of the pest insects are general feeders that attack many different kinds of plants, and these should be recognized by the commercial pesticide applicator.

Ornamental pest insects may be divided into two groups by the way they feed: (1) sucking types (i.e., scales, aphids, mealybugs, whiteflies, true bugs, thrips and mites); and (2) chewing types (i.e., grasshoppers, beetles, sawflies, and caterpillars).

Insects with Sucking Mouthparts

Damage by pests with sucking mouthparts is basically similar. The mouthparts are used to pierce or rasp plant tissue so they can suck up plant juices. Damaged foliage is usually mottled, but other symptoms may also occur such as wilting, scorched leaf tips, or puckering and curling. When sooty mold occurs on plants, it is almost always associated with 'honeydew' that is produced by certain kinds of sucking insects.

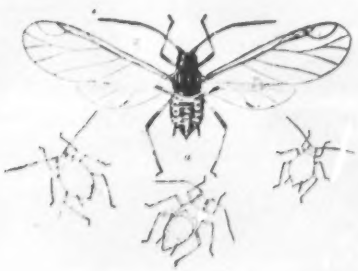

Figure 17. Aphids

Aphids:

Aphids, or "plant lice", are small, soft-bodied insects that usually cluster on stems or undersides of leaves. Aphids may be green, black or red, but sometimes their color may be hidden by a white waxy coating. Much of the sap that aphids suck passes through them undigested, as 'honeydew'. 'Honeydew' that drops on leaves causes the leaves to be sticky, and sooty mold may also develop on these leaves. Some kinds of aphids will cause leaves to pucker, curl or twist. Aphids are common on roses and snowball, especially during the eearly part of the season.

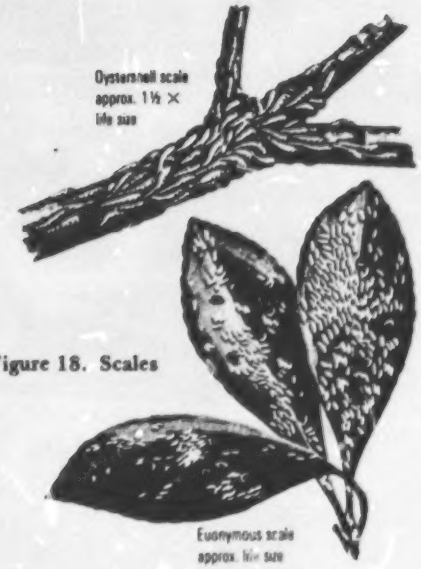

Figure 18. Scales

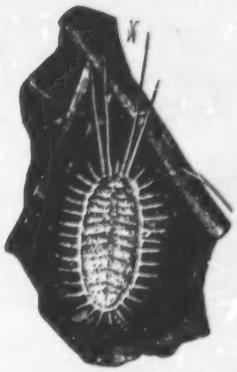

Figure 19. Mealybugs

Figure 20. Whiteflies

Scales:

During most of their life, scale insects are legless and motionless and may not resemble insects at all. They may be circular, oval or pear-shaped. Some are flat, but others may be quite convex. Two major groups of scales are most common in Kentucky. The armored scales produce a waxy shell which gives the soft-bodied insect under it some protection. The unarmored scales do not produce a shell, but their bodies may be as tough as the shells of armored scales.

Scales reproduce by giving birth to 'crawlers' or by laying eggs which hatch into 'crawlers'. 'Crawlers' have legs, eyes, and antennae, all of which allow them to move out from under the mother's shell or body and seek a suitable place of their own on the plant. When they insert their beak they soon molt and lose their legs, eyes and antennae and are motionless from then on.

Plants infested with scales may lack vigor and appear unthrifty. Unarmored scales are 'honeydew' producers like aphids and cause the same problems as mentioned for aphid 'honeydew'.

Most scales are easier to control while they are in the crawler stage, since they are not protected by a shell or waxy coat. For scale control in general, apply approved contact insecticides to coincide with 'crawler' activity and re-treat 2 to 3 weeks later. Timing of systemic insecticide applications is not so critical. On oil-tolerant plants, oil sprays can be used to control all stages of scales, including eggs.

Mealybugs:

Mealybugs are special types of scales that differ from typical scales in that they can move about slowly throughout their lives. They are soft-bodied and covered with a white, powdery or cottony or mealy wax-like material. Mealybugs suck juices from stems and leaves, an activity which stunts or even kills plants. Black, sooty mold often grows on 'honeydew' deposited by mealybugs. The unthrifty look of azaleas is often due to mealybug infestation.

Whiteflies:

Whiteflies are small, powdery-white insects that resemble tiny moths in appearance. There are

several kinds, but the greenhouse whitefly is the only one that is an important pest in our area. The immature stages of whiteflies resemble immature scale insects. Both the adults and immature stages suck sap from the leaf undersides of host plants. When an infested plant is disturbed, the adult insects flutter off but settle back down very quickly. Besides ornamentals and flowers, the greenhouse whitefly also infests many different vegetables, shade trees and weeds. Infested plants lack vigor, turn yellow, wilt and may die. Leaves may also be covered with sooty mold growing on 'honeydew' these insects produce.

Figure 21. Thrips

Figure 22. Mites

Thrips:

Thrips are tiny, slender insects with rasping-sucking mouthparts. Adult thrips may be yellow, brown, or black and have feathery wings held flat on the back. Immature thrips resemble adults but are lighter in color and wingless. Some species feed primarily on foliage while others feed primarily on blooms. The foliage of thrips-infested plants may be streaked or silvered; flowers may be deformed or have brown-edged petals; or the flower buds may fail to open or drop off. The protection of plants from flower thrips is difficult during May and June when the thrips are migrating and continually reinfesting plants.

Mites:

Mites are not insects but their damage and the methods for control are similar to those of insects. They differ from insects in having 8 legs instead of 6, and they have only 1 body region instead of 3. They never have wings as most insects do. All mites are tiny and usually cannot be seen except with the aid of a magnifying lens. By tapping infested twigs over a sheet of white paper, the dislodged mites are much easier to detect. They vary widely in color. Some mites spin fine, delicate webbing on the host plant and this is usually easier to detect than the mites themselves. Mite damage often appears as a bronzing of the foliage, which sometimes gives it a dusty appearance. Leaf drop may also occur and the entire plant may have an unthrifty appearance.

Many kinds of plants are attacked by the two-spotted spider mite and almost all coniferous plants are hosts to the spruce spider mite.

Insects with Chewing Mouthparts

Figure 23. Beetles

Beetles:

Beetles vary considerably in size, shape, color and habits. One of their most distinctive features is that their front wings are hard or leathery and meet in a straight line down the center of the back.

Beetles may attack any part of a plant and in various ways. Some are typical leaf feeders and bite

off pieces of leaf, while others are leaf miners or skeletonizers. Among some beetles the adults and larvae both are leaf feeders on the same plant; other beetles may be foliage feeders as adults and root feeders on other plants while in the larval stage. Some feed during the day and some feed only at night.

Figure 24. Caterpillars

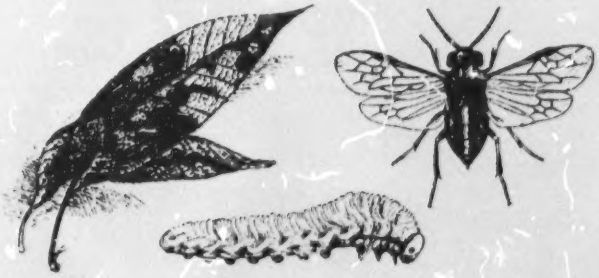

Figure 25. Sawflies

Caterpillars:

Caterpillars are the worm-like immature stages of moths and butterflies. They range in size from tiny to 5 inches long. They usually have a distinct head and 4 pairs of fleshy legs on the middle of the body. The body may be fuzzy or naked and smooth or spiny.

Caterpillars are primarily foliage feeders and eat out irregular areas or may entirely strip the leaves.

Some caterpillars, because of their special habits, are also referred to as webworms, tent caterpillars, leaf rollers, leaf folders, skeletonizers, bagworms, and some leaf miners. Some feed as individuals; others feed in groups or colonies.

When only a few large caterpillars are present, handpicking is effective. Webworms and tent caterpillars can either be pruned out or burned out with a torch. If pruning would adversely affect a plant or if the infestation of any caterpillar is generally distributed over a plant, a single treatment of an approved insecticide applied when the caterpillare are young will usually give control.

Sawflies:

Sawflies are wasp-like insects and are related to typical wasps, bees and ants. The larval stages of most sawflies resemble naked caterpillars in appearance except that they have more than 5 pairs of fleshy legs on the body while caterpillars have only 4 or fewer pairs. Some sawfly larvae are slug-like in appearance, such as the pear slug and rose slug.

Most sawfly larvae are external foliage feeders that eat the entire leaf, but slug sawflies are skeletonizers. A few types of sawflies are wood borers or leaf miners and further differ from typical sawflies in that they do not have fleshy abdominal legs.

The most serious sawfly pests in our area are those that attack coniferous shrubs and trees. They feed in groups and can quickly defoliate a plant, which often leads to the plant's death. A single application of an approved insecticide is usually sufficient for control.

TURF AND ORNAMENTAL WEEDS

The definition of a weed is "a plant growing where it is not wanted." By this definition any member of the plant kingdom may be called a weed. Weeds present some rather special problems in the production and maintenance of quality turf and ornamental plantings. Certain grasses and broadleaf weeds that are permitted to grow in these areas reduce their aesthetic value. Herbicides must be chosen with considerable care to prevent possible injury to desirable species.

Weeds can be divided into (a) annuals, (b) biennials, and (c) perennials, all three categories requiring somewhat different approaches for their control.

All weed control efforts in a turf and ornamental situation must be selective, since the intent is to remove the undesirable species which are growing in close proximity to desirable species.

The following list includes some of the most common weeds found in turf and ornamental plantings.

Figure 26. Crabgrass, *Digitaria* spp. A. creeping base and rooting at lower joints of stem. B. arrangement of flower and seeds on finger-like head.

Figure 27. Goose-grass, *Eleusine indica*. A. stems arising from tufts. B. finger-like flower and seed head.

Figure 28. Nimblewill, *Muhlenbergia schreberi*. Entire plant, showing slender creeping stems, ascending seed heads.

Crabgrass (Digitaria spp.)

Two common species of crabgrass are found in Kentucky. Since their life habits and control measures are similar, they will be treated as one.

This annual grass reproduces by seed and by rooting at the lower joints of the stem. The stems are erect or arise from a creeping base and usually form mats. Small, inconspicuous flowers are produced in two rows along one side of the 3 to 10 finger-like branches at the top of the stem.

In Kentucky, crabgrass seed starts to germinate in late April or early May. It thrives best during warm summer months when bluegrass is making the least amount of growth. Crabgrass grows to maturity and develops seed from July until September, then dies in autumn.

Goose-grass (Eleusine indica Gaertn.)

Other common names for this weed are wire-grass, yard-grass and crowfoot-grass.

This smooth, flat-stemmed, coarse annual grass reproduces entirely by seeds. Stems are branched, arise from tufts, and often form mats. Flowers and seeds are produced in two rows along one side of the 2 to 10 finger-like branches at the top of the stem. Goose-grass may look like crabgrass; however, goose-grass differs since it has a flattened stem and does not take root at the lower joints of the stem.

Goose-grass germinates in April and May, produces seed from June to September, and dies in autumn.

Nimblewill (Muhlenbergia schreberi J. F. Gmel.)

Other common names of this plant are drop-seed and wire-grass. This grass is becoming one of our most troublesome weeds in Kentucky lawns.

Nimblewill is a shallow-rooted perennial grass that spreads by seeds and underground stems. The stems are slender, branched, and spread along or near the surface of the ground. Tiny, inconspicuous flowers and seeds are arranged loosely on nodding or ascending branches along the upper part of the stem. The leaf blades are usually less than 1/4 inch wide and not more than 2 inches long. Nimblewill is grayish-green in color compared with the darker green bluegrass.

New growth of nimblewill starts from the underground stems in February and early March. It continues to grow throughout the summer and early autumn. The roots remain alive throughout the year, but the tops die in autumn, leaving dense brown mats in the lawn during the winter.

Figure 29. Annual bluegrass, *Poa annua*. A. plant showing tuft of stems. B. pyramid-shaped seed head.

Figure 30. Foxtail, *Setaria* spp. Entire plant showing erect stem with seed head at the top.

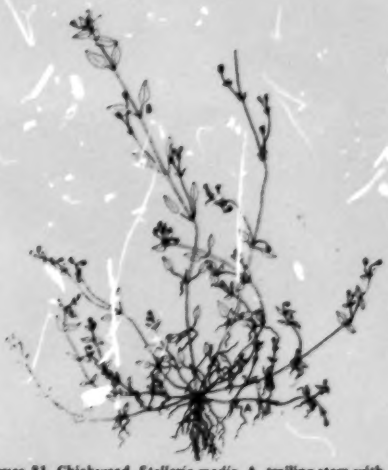

Figure 31. Chickweed, *Stellaria media*. A. trailing stem with roots at joints. B. pair of opposite egg-shaped leaves.

Annual Bluegrass (Poa annua L.)

Other common names for annual bluegrass are annual speargrass, dwarf spear-grass and six-weeks grass.

This plant is an annual or sometimes winter annual that reproduces entirely by seed. Stems are flattened, grow in tufts, and sometimes take root at the lower joints. The leaves are very soft, and the seed heads are arranged in the shape of a pyramid.

Annual bluegrass thrives best during cool weather. Germination occurs in late winter and early spring. The plant grows to maturity, develops seeds and then dies in late spring or early summer, leaving unsightly brown areas in the lawn. Annual bluegrass is often lighter green in color than Kentucky bluegrass. It usually grows from 4 to 8 inches in height.

Foxtail (Setaria spp.)

Other common names are summer-grass, pigeon-grass and wild millet.

Foxtails found in Kentucky lawns are annual grasses that reproduce entirely by seed. The stems are erect and may grow from 12 to 48 inches high. In lawns that are regularly mowed they will develop seed heads just above the soil surface. The stems are somewhat flattened, and the leaves may vary from 1/2 to 1 1/2 inches in width. Seed heads develop at the top of the stems and vary from 2 to 6 inches in length.

Chickweed (Stellaria media Cyrill)

Other common names are starwort, starweed, winter-weed and satin flower.

Chickweed is a juicy-tissued, shallow-rooted winter annual that reproduces by seed and trailing

stems which take root at the lower joints. The leaves are arranged in pairs on the stem; they are usually egg-shaped, smooth, and less than 1 inch long—the lower leaves with hairy stalks and the upper without stalks. The flowers are small, with five white, deeply-notched petals.

Chickweed starts to germinate in the autumn, grows throughout the winter, develops seeds from April until early summer, then dies. Occasionally some chickweed may continue to grow during the summer, but most of the plants die during late spring.

Figure 32. Wild garlic, *Allium vineale*. A. underground bulb. B. head of aerial bulblets. C. leaf base surrounding stem.

Figure 33. Henbit, *Lamium* spp. A. pair of opposite somewhat circular leaves with rounded teeth or lobes. B. flower whorl at base of leaves.

Figure 34. Buckhorn plantain, *Plantago lanceolata*. Note leafless stem with short, dense flower spike at top and narrow, prominently veined leaves arising from basal rosette.

Wild Garlic or Wild Onion (Allium vineale L.)

Wild garlic, a perennial that looks like the cultivated onion in appearance, reproduces by underground bulbs and bulblets above the ground. Stems are 12 to 24 inches tall, the lower part covered with leaf-bases around the stem. Leaves are hollow, slender, and around in earlier stages of growth, becoming grooved as the plant develops. The greenish-white to purple flowers are often replaced with bulblets, each containing a long, slender appendage. These bulblets are arranged in umbrella-like clusters near the top of the stem.

Wild garlic has two kinds of underground bulbs. The soft-shelled bulbs germinate in autumn, while the hard-shelled bulbs remain dormant until succeeding years. Some bulbs remain alive in the soil for at least five years.

Henbit (Lamium spp.)

Other common names are dead nettle, winter mint, blind nettle and bee nettle.

Henbit is a winter annual that reproduces by seeds and stems rooting at the lower joints. The stems are 4 to 16 inches tall, square, and branch close to the ground. The plants are erect and have very few or no hairs. The leaves are opposite (two leaves at each stem joint), almost circular, with the edges having rounded teeth or lobes. The flowers are pink to purple, two-lipped, and arranged in whorls at the base of the leaves.

The growth habits of henbit are like those of chickweed.

Buckhorn Plantain (Plantago lanceolata L.)

Other common names are buckhorn, English plantain, narrow-leaved plantain and buck plantain. Buckhorn plantain is a perennial that reproduces by seed and new shoots from the roots. The

stems are usually from 8 to 16 inches high, leafless, and bear a short, dense flower spike at the top from 1 to 3 inches long. The narrow leaves arise from the base of the flower stems; they are 4 to 8 inches long, lance-shaped with several prominent veins running lengthwise, and are arranged in a basal rosette at the surface of the soil.

Buckhorn plantain produces mature seed from June to September.

Figure 35. Broad-leaved plantain, *Plantago major*. A. stem with long slender flower spike. B. broad, somewhat egg-shaped leaves arising from basal rosette.

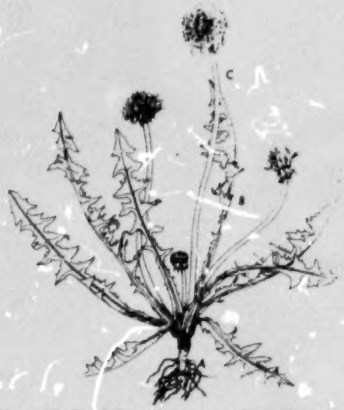

Figure 36. Dandelion, *Taraxacum officinalis*. A. upper section of long taproot. B. coarsely toothed leaves from basal rosette. C. flower head on long, hollow stem.

Figure 37. Red Sorrell, *Rumex acetosella* L. Plant showing creeping root system (A) and the leaves with their characteristic lobes (B).

Broad-leaved Plantain (Plantago major L.)

Other common names are common plantain, whiteman's-foot, and dooryard plantain.

Broad-leaved plantain is a perennial that reproduces by seeds and new shoots from the roots. The stems are usually 4 to 12 inches high and leafless, with a long, slender flower spike at the top which is from 2 to 10 inches in length. The leaves arising from the base of the stem are broad, somewhat egg-shaped, with several prominent veins, and are arranged in a basal rosette at the surface of the soil.

Broad-leaved plantain produces seed from June to September.

Rugel's plantain (Plantago Rugelii) looks very much like P. major; and since control measures are the same for both species, they are treated as broad-leaved plantain in this publication.

Dandelion (Taraxacum officinalis Weber)

Other common names are lion's-tooth, blow-ball, and cankerwort.

Dandelion is a perennial that reproduces by seeds and new shoots from the roots. The stems contain a milky juice and arise from a long, thick, fleshy taproot. The leaves vary in shape, are usually oblong and more or less tapering in outline. They vary from having no teeth to coarse teeth, usually are covered with short soft hairs, and are arranged in a basal rosette. The yellow flowers are arranged in a single head on a long hollow stalk.

Dandelions produce most of their flowers in May and June.

Red Sorrel (Rumex acetosella L.)

Other common names are sheep sorrel, field sorrel, sourweed, red-top sorrel, sour-grass, and horse sorrel.

Red sorrel is a perennial that reproduces by seeds and creeping roots. Low stems, usually less than 18 inches high, are scattered or in mats and produced from creeping roots. Upper leaves may be somewhat long and narrow with the lower leaves shaped somewhat like an arrowhead but with two small lobes at the base.

The plants produce seeds from late April to September. The seeds are small, triangular shaped, reddish brown, and glossy.

TURF DISEASE INFORMATION

Numerous disease problems occur on turfgrass in Kentucky and these frequently cause extensive damage. In many cases, a disease is blamed for poor quality turf when, in reality, it may be only a contributing factor or not involved at all. Frequently, dead and dying grass is caused by improper fertilization, chemical burn, mower problems, dog or insect injury, dry or wet spots, thatch, competition from other plants or from any other improper management. Accurate diagnosis of the problem is essential if proper control is to be obtained.

Two types of pathogens (fungi and nematodes) are of significant importance to turf in Kentucky. Observation of symptoms is an important aid in determining which pathogen is causing a disease. The following information will explain the identification and biology and some common turf diseases.

Figure 38. ***Helminthosporium*** **Leaf Spot**

Helminthosporium Disease

Helminthosporium leaf spot is a common disease problem of bluegrass and is often referred to as "melting-out." Other *Helminthosporium* leaf spots are important on fescues and bermuda. From a distance, leaf spot-affected areas appear chlorotic or yellowed. Individual spots on the leaves have dark margins with tan centers. The spotting is most noticeable in spring and early summer. Infection in the

crown of the plant during the summer can lead to the death of plants (thus "melting-out"). Drought accentuates the damage from this disease.

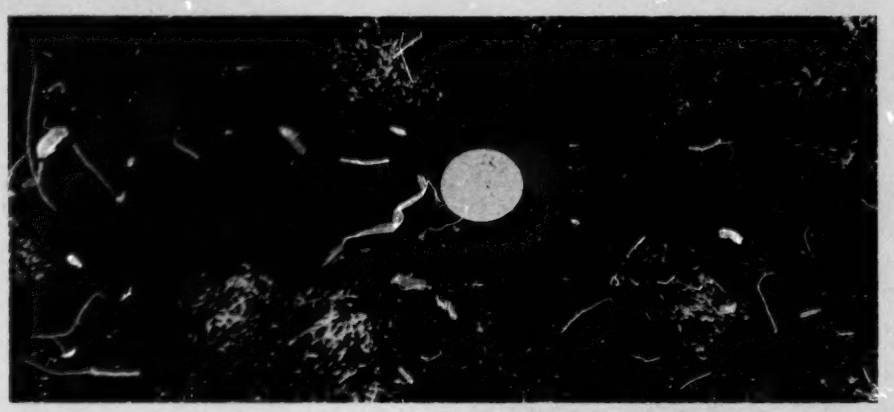

Figure 39. Dollar Spot

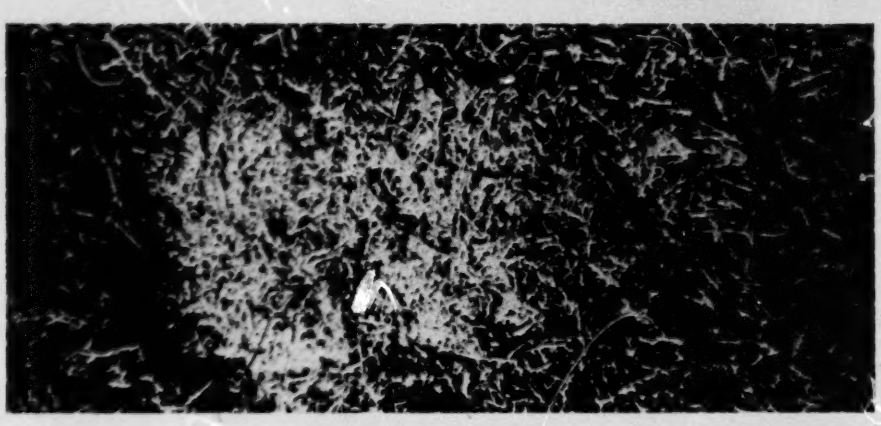

Figure 40. *Pythium* Blight

Dollar Spot

Dollar spot affects a wide variety of grasses, including blue bermuda, rye, zoysia, fescue, and bent grasses. The fungus is active throughout the growing season, especially when there is low soil moisture and an excess of dew or fog. It is most prevalent in the spring. The disease is characterized by small spots, one or two inches in diameter. Large numbers of spots can come together and form larger dead areas. Leaf spots are usually found along the edges of the grass blade and may come together across the blade, causing the tip to die. Individual leaf spots are tan colored with reddish margins. Dollar spot usually causes very little damage to a properly fertilized lawn.

Pythium Blight

Pythium blight is caused by a number of species of the fungus *Pythium*. The fungus attacks blue, bermuda, fescue, rye, bent, and zoysia grasses. Cool season grasses are especially susceptible to this disease. Conditions which favor *Pythium* blight are an abundance of moisture and poor air circulation. The disease is most active in hot humid weather when the night temperature does not go below 70° F.

The blight appears first as small spots a few inches in diameter. Diseased leaves are at first water-soaked, soft, slimy, and may mat together. The leaves soon shrivel and the color of the patch soon fades to light brown. The shape of the diseased area may be streaked, following the drainage flow of water over the turf.

Figure 41. Brown Patch

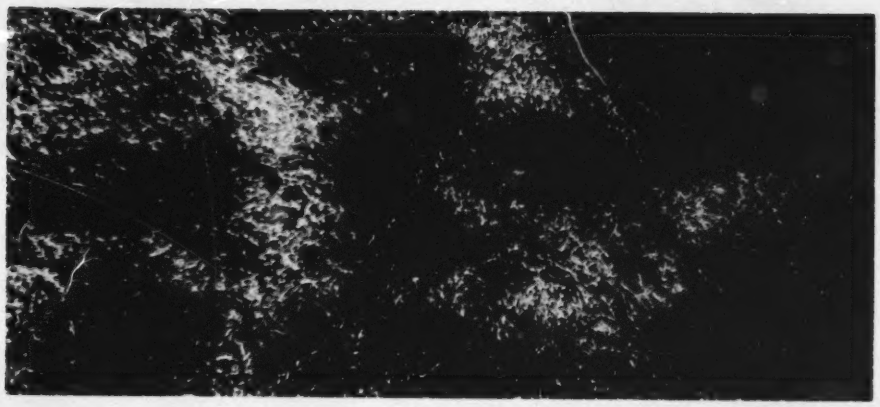

Figure 42. *Fusarium* Blight

Brown Patch

Brown patch is a common fungal disease of fescue, bluegrass, bermuda, rye, bent, and zoysia grasses. The disease develops most readily at temperatures between 80-85°F. and is one of the more common turf diseases. In addition to ideal temperatures and humid weather, heavy applications of nitrogen fertilizer favor disease development. Brown patch is characterized by nearly circular dead areas which may be a few inches to several feet in diameter. The edges of the dead area may have a gray, smoky color, particularly in early morning. Affected areas are generally brownish in bermuda, blue, zoysia, bent, and rye grasses. Affected fescues usually have straw-colored leaves.

Fusarium Blight

Fusarium blight can be observed in turfgrass initially as scattered light green patches which change in color to dull, reddish brown, and then to tan, and finally to a light straw color. The shapes

of the affected areas may be elongate streaks, crescent, circular patches, or rings of dead grass. Under conditions of high temperature and high humidity, the disease may progress until large areas of turfgrass may be completely blighted.

On individual leaves, the disease is characterized by dark green blotches which fade to a light green, then reddish brown and tan color. The disease is common on blue, fescue, bermuda, bent, rye, and zoysia grasses.

Rust

Rust is sometimes a problem on blue, fescue, zoysia, rye and bermuda grasses. Rust infection results from rust spores which are blown to the plant from distant areas or from nearby alternate hosts. Large numbers of spores are produced in the leaf spot (pustule). These spores are then the source of new infections. The disease is most frequently found during mild, humid weather. Grass varieties differ in susceptibility to rust.

Figure 43. Mushroom Fairy Ring

Mushroom Fairy Ring

Fairy ring can occur in any turf. The ring appears as a circular discoloration of grass from several inches to many yards in diameter. Mushrooms (toadstools) may appear at the edge of the ring during warm, moist periods. The ring of grass is generally a darker green than the grass inside and outside the ring. During periods of moisture stress the grass inside the ring may die. This general decline of grass inside the ring adds to the unsightliness of the fairy ring problem. Fairy rings gradually increase in size.

Figure 44. Slime Mold

Slime Mold

Slime molds are commonly found on lawns in warm, moist weather. This fungal growth on grass leaves may be either a small, crust-like, light to dark grass mass with a sooty appearance or a tan to orange shapeless mass. The fungus causing this unsightly problem does not infect the grass blade but simply uses it for support. The only effect which it has on the plant is to reduce food production by the grass blade as a result of shading.

Nematodes

Nematodes weaken and reduce the vigor of turfgrasses by restricting the development of the root system. The symptoms of nematode injury may be confused with nutritional problems, insufficient water, hardpan, or any factor which restricts root development. Symptoms commonly associated with nematode injury include thinned or completely killed areas, pale green to chlorotic color, excessive wilting during drought stress, poor response to fertilization, and a greater weed problem due to sparse grass. The intensity of the symptoms observed will vary with the grass variety, the kinds of nematodes present, the nematode population level, and the fertilization-watering program being practiced. The most reliable method for determining whether or not a nematode problem exists is by means of a soil assay.

TURF INSECTS

The two most common insect pests of turf are white grubs and sod webworms. Occasionally, isolated incidences of chinch bug, armyworm and other pests also occur.

White Grubs

White grubs are the larval stages of several kinds of scarab beetles. The most common of these beetles are green June beetles, May beetles, masked chafers and Japanese beetles. The larval stages of

Figure 45. White Grubs

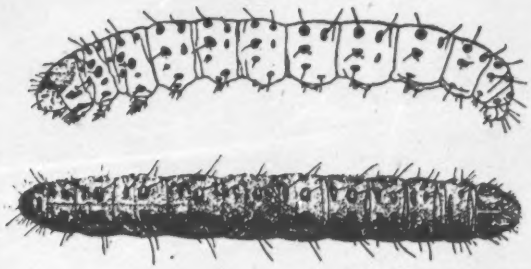

Figure 46. Sod Webworms

all these beetles are quite similar in appearance. They are fat and white and have a distinct brown head. They generally lie in a C-shaped position just a few inches below ground level in sod where they feed on the roots. When the roots have been cut off by grubs, the sod can be lifted as if it were newly laid sod. When the sod is under stress from dry weather, the sod dies in large patches where the white grubs have been feeding.

For further information on these pests see University of Kentucky Cooperative Extension Service publications ENT-5 and ENT-10.

Sod Webworms

Sod webworms are the caterpillar stages of several kinds of small buff-colored moths. The caterpillars live in silk-lined, grass-covered tubes near the soil surface of bluegrass sod. The caterpillars are grayish, with small dark spots on their bodies, and dark heads. Each caterpillar closely clips grass over a baseball-sized area, but these areas may run together and larger areas may be damaged. Hot dry weather causes the webworm-grazed areas to die out.

For more information on sod webworms see University of Kentucky Cooperative Extension Service publication ENT-7.

BE INFORMED

The following are suggestions of things to know if you are responsible for ornamental and turf pesticide application:

1) You should know your local agricultural and horticultural Extension agents. Ask them for printed information on local pest control recommendations, pesticide usage, precautions to follow, and results to be expected. Keep current copies of pesticide suggestions and spray schedules.
2) Know as much as possible about the insect, weed, and disease problems of the turfgrasses, flowers, trees, and shrubs that you are responsible for. If you cannot identify a problem or need to know how much of a threat a particular pest may represent, get help from your county Extension office.
3) You should know about cultural and biological control alternatives to applying a pesticide. Select the safest, most effective, and most economical means of control.
4) Learn to recognize beneficial insects such as ladybird beetles, syrphid flies and aphid lions. Carefully check for insects dead or dying from disease. Know what effect weather conditions

may have on insect pest buildup. Avoid using pesticides if natural forces are likely to bring the pest population under control.

5) Remember that many environmental conditions such as temperature extremes, water or humidity, air pollutants, pesticide injury and other noninfectious agents can produce symptoms that mimic plant disease, mite or insect injury.

6) Know the resistant turfgrass, flower, tree and shrub varieties recommended for Kentucky. Encourage use of varieties or species that are more tolerant of pests.

AVOIDING PHYTOTOXICITY

Phytotoxicity, or unintentional pesticide damage to plants, results in such things as abnormal growth, foliar burn, leaf drop, and discolored, curled, and spotted leaves. If phytotoxicity is severe, the plant may die. Phytotoxicity often resembles such other problems as insect damage, plant disease, and response to poor growing conditions such as insufficient moisture and improper fertilization. The following items contribute to the problem of accidental plant injury by pesticides:

1. The wide variety of plant material involved in ornamental pest control.
2. Pesticide drift.
3. Pesticide persistence beyond the intended period of pest control.

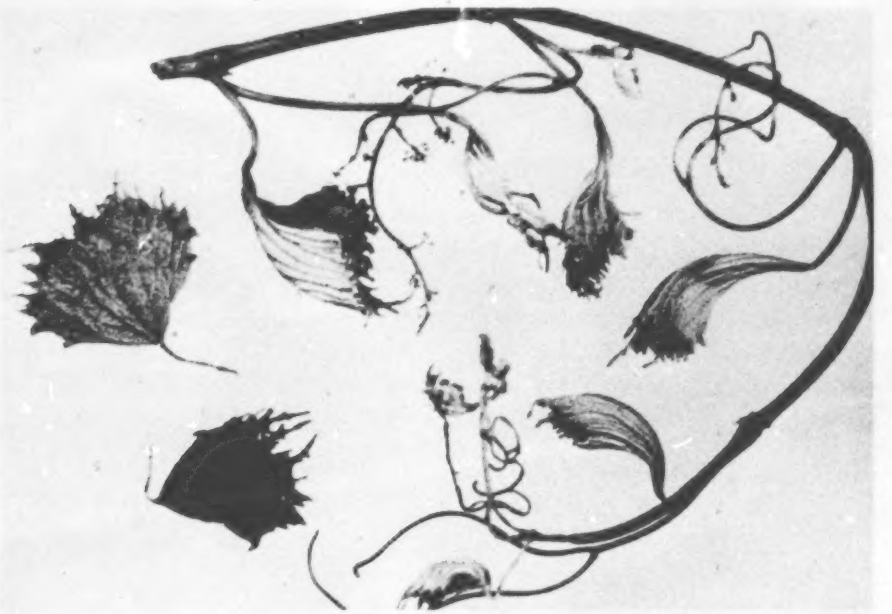

Figure 47. 2,4-D herbicide injury to grape

Wide Variety of Plant Material

Ornamental plants include herbaceous, semi-woody, and distinctly woody species. Generally, herbaceous plants (chrysanthemums, petunias, turfgrasses, etc.) are more susceptible to pesticide damage than woody plants, and the woody plants are more susceptible when growth is young and tender.

Accidental plant damage is most likely to occur with herbicides, since their function is to injure certain kinds of plants. For example, herbicides used to kill broad-leaved weeds in turfgrasses may also injure broad-leaved ornamental trees, shrubs, and flowers if not used properly. Insecticides and fungicides can cause injury to certain sensitive species of plants and also to normally tolerant plants under unusual conditions such as hot weather. The pesticide label is the best guide to the safe use of pesticides on a specific ornamental plant. If the pesticide is not known to be safe for use on a specific ornamental plant, it should not be used. Greenhouses present a special problem, since phytotoxic vapors tend to be trapped in the closed environment, exposing all plants within the greenhouse to the pesticide.

Drift Problems

The proximity of different plants with varying susceptibility to pesticide damage requires that commercial ornamental and turf pesticide applicators be especially aware of drift problems. There are several steps that can be taken to prevent damage to non-target plants.

Drift can be prevented or minimized by using methods described in a later section. Pesticides should be selected that are safe for both target and non-target plants if possible. It may be necessary to place a barrier around the target plant or remove susceptible plants from the area (such as removing susceptible potted plants from a greenhouse). A decision may have to be made whether or not to apply a pesticide to the target plant if the benefit does not justify the hazard to nearby plants.

Persistence Beyond the Intended Period of Control

Persistence is an important part of pest control, since successful pest control requires a knowledge of the persistence period to make subsequent applications. A persistent chemical has an advantage for long term control of the pest since fewer applications are needed to obtain pest control.

The period of pesticide residual activity varies greatly from one class of pesticides to another. Persistence is directly related to rate of application, soil type or texture, temperature, moisture conditions, rainfall and other factors. Commercial applicators must be familiar with the persistence of each pesticide which may be applied to ornamentals and turf, especially where adjacent areas may be affected or where treated soil is used to grow other plants. When different plants are rotated in the same soil, phytotoxicity can be a problem because a pesticide used to control some pests on one plant may leave residues in the soil that will damage or kill another plant. Information on the persistence of a given pesticide can be found on the product label.

MINIMIZE PESTICIDE HAZARDS TO THE ENVIRONMENT

Turf and ornamental pesticides must often be applied in environments frequented by humans, as well as pets and other domestic animals. The pesticide applicator must be constantly alert to the hazard associated with this situation. Primarily, the problem is twofold: (1) hazardous amounts of pesticides must be prevented from drifting into non-target areas; and (2) humans, pets, and other animals must be prevented from contacting hazardous amounts of pesticides within the treated area. Many of the procedures used in protecting plants from phytotoxicity can be applied to protecting animals from pesticide damage.

Preventing or Minimizing Drift

Where several pesticides are available, the applicator should strongly consider the hazard and toxicity of the active ingredient in making a choice. He should use formulations and methods of application that will result in minimum drift.

Air blast sprayers can be used in ornamental and turf pest control if very safe pesticides are used (toxicity to applicator and non-target plants is low). Air blast sprayers should never be used to apply herbicides.

Two types of drift are associated with pesticides. The most common, drift of spray droplets or dust particles, is directly affected by such things as spray pressure, nozzle opening size, wind velocity, and pesticide formulations. Movement of a chemical with low vapor pressure, termed "vapor drift," is a second kind of drift. Vapors or gases can drift in harmful concentrations--even in the absence of wind. Fumigants, such as methyl bromide, must be confined so they will not drift from the treated area (proper sealing with a plastic tarp is essential). Some pesticide products are volatile or capable of vaporizing from soil and leaf surfaces in potentially harmful concentrations after application. Herbicide vapor can severely damage and even kill desirable plants.

Protecting Humans, Pets, and Domestic Animals from Hazardous Residues in the Treated Area

Before applying a pesticide, the application site should be cleared of such things as toys, pet food dishes, bird feeders, and other articles. Pesticide residues on these articles can be a hazard.

Animals and humans should be kept from the area during pesticide application. (They should also be kept from the area of potential drift and run-off until the spray has dried or the dust has settled, regardless of the toxicity of the pesticide used.) Some pesticides may be potentially hazardous for a longer time, therefore, label directions concerning re-entry should be closely adhered to.

The use of a highly toxic systemic insecticide on plants just before they are sold to the public must be avoided. It is very possible that in the process of selecting a plant, the soil would be handled and the general public would be exposed to the active chemical. In situations such as this, it is necessary to hold the plants until the chemical has lost its toxicity. Recently sprayed ornamental plants with showy flowers or edible fruits present a special hazard because they are likely to be handled or even eaten by children.

APPLICATION TIPS

Specific factors to keep in mind when applying pesticides to ornamentals and turf include:

1) Use the proper sized sprayer or duster for the job at hand. Smaller equipment is often more useful around home landscapes. Use the right kind of nozzles.
2) Use separate spray equipment for certain types of weed control work. Many herbicides cannot be completely washed out of the spray tank.
3) Carefully adjust and calibrate equipment.
4) Consider using equipment that is convenient to mount and dismount as well as to operate.
5) Use proper pressure for spraying. Avoid high pressures (above 30 psi) for weed control work.
6) Be sure that everyone in the spray crew knows what chemical or pesticide is being applied.

7) Never leave spray puddles on hard surfaces that may attract children, pets, or birds.
8) Do not use highly toxic insecticides such as parathion, methyl parathion, TEPP, Systox, Phosdrin and Demeton for insect and mite control on trees, shrubs, lawns, and flowers. There are chemicals available of comparable effectiveness that are far less toxic.
9) The efficiency of some pesticides can be improved by the addition of surfactants (spreader-stickers) to the spray mix.
10) Use the amine formulation of 2,4-D and not the ester form which is more volatile and likely to cause drift problems.
11) Know where beehives are and notify the beekeeper before applying insecticides to nearby areas. Sevin is very toxic to bees. The safest time to apply insecticides to plants without harming honey bees is in the evening after 7 p.m.
12) Do not apply any fungicide or insecticide spray when the temperature is 85° F or above. Early morning or early evening application is best in hot weather.
13) Do not apply fungicide-oil sprays if the temperature is below 45°F.
14) Prepare only enough spray to complete the job at hand.
15) Never use unlabeled or unregistered pesticides.
16) Before applying a pesticide, be absolutely sure where and what to spray. If you are a supervisor, give explicit instructions that cannot be misunderstood.

SAFETY TIPS

1. Transport pesticides in truck beds—not in the driver's compartment. Do not transport pesticides, other than small packages of household pesticides, in the passenger compartment or trunk of a vehicle. Pesticide fumes can be dangerous and in case of an accident, the pesticide container may rupture and spill on the occupants.
2. Observe directions, restrictions, and precautions onpesticide labels. Failure to do so is not only dangerous or wasteful; it is also illegal.
3. Mix pesticide solutions in a well-ventilated area, preferably outside. Avoid inhaling pesticide sprays or dusts.
4. Use pesticides at correct dosages and intervals to avoid excessive residues and injury to plants and animals.
5. Apply pesticides carefully to avoid drift especially where water supplies, vegetable gardens, or fruit trees are nearby.
6. Proper safety equipment and needed protective devices should be used. While these devices may be available, they serve no purpose unless used.
7. Never smoke, drink, or eat while handling or applying pesticides.
8. Store all pesticides behind locked doors in original containers with labels intact.
9. Dispose of surplus pesticide containers so that contamination of water and other hazards will not occur.

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